

PATENT APPLICATION
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of

for

DATA SOURCE INTERFACE LOG FILES

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DATA SOURCE INTERFACE LOG FILES

This application is a divisional of application Serial No. 09/612,534 filed on July 7, 2000 for LIVE CONNECTION ENHANCEMENT FOR DATA SOURCE INTERFACE.

BACKGROUND OF THE INVENTION

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Field of the Invention

The present invention relates generally to the management of a remote application connection to a data source. More particularly, the present invention relates to identifying a status corresponding to interactions between a remote application and a data source.

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Relevant Technology

Databases are computerized information storage and retrieval systems. A Relational Database Management System (RDBMS) is a database system which uses relational techniques for storing and retrieving data. Relational databases are organized into tables consisting of rows and columns of data. A database typically includes many tables, and each table includes multiple rows and columns. The tables are conventionally stored in direct access storage devices (DASD), such as magnetic or optical disk drives, for semi-permanent storage.

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Generally, users communicate with an RDBMS using a Structured Query Language (SQL) interface. The SQL interface allows users to create, manipulate, and query a database by formulating relational operations on the tables, either interactively, in

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5 batch files, or embedded in host languages such as C and COBOL. SQL has evolved into
a standard language for RDBMS software and has been adopted as such by both the
American National Standards Institute (ANSI) and the International Standards
Organization (ISO).

A common application for databases relates to their interaction with Internet web
10 browsers. A remote application such as a web browser may be used to query data from a
data base. The data may then be used to create a table or other display of information on
the web browser. This requires the transfer of data files and the formatting of data on the
web browser. As the database is responsive to SQL and a web browser requires an
HTML format, an interface module is required to enable interaction between the web
15 browser and the database. One example of such an interface module is Net.Data
available from IBM Corp., Armonk, New York.

Net.Data enables Internet and Intranet access to relational data on a variety of
platforms. Net.Data incorporates a macrolanguage which supports both HTML and SQL
and allows for interaction with universal web browsers and relational database systems.
20 Net.Data operates in conjunction with a web server interface and supports client-side
processing as well as server-side processing with languages such as Java, REXX, Perl and
C++. Net.Data provides database connectivity to a variety of data sources including
information stored in relational databases, flat files Java files, Perl files and the like.

Net.Data may support a variety of operating systems, including OS/2, AIX,
25 Windows NT, HP-UX, Solaris, SCO, OS/390 and OS/400. Net.Data is further able to

5 cache web pages to improve application performance, particularly when repeated requests
are made for the same web page. Although this invention is compatible for use with an
interface module such as Net.Data, other common gateway interface applications may be
used with the present invention as well.

10 The interface module, which may be resident on a server, receives a query from a
web browser, formats the query into SQL, and interacts with the database to receive data
and create the table or other display of information. The interface module then uses its
macrolanguage to present the data to the web browser in HTML format. The web
browser, in turn, displays the data to a user of the remote application. In this manner, the
interface module serves as an Internet gateway for accessing a database. However, every
15 time the interface module connects to the database, requests a connection set up for the
database, or sends a query to get data results from the data base, the interface must
perform a set of time-consuming processes such as initialization, authorization, password
confirmation, and the like. These processes can be time consuming, slowing down the
entire system and process.

20 One attempt to overcome the problem of slower connections was to create a
database manager to assist in synchronizing the connection of the interface modules with
various ports of the database. However, in order to accommodate numerous web
browsers, multiple applications of an interface module may be running, which may
complicate the system. With increased use and complication, the system may be difficult
25 to debug when a problem arises. Additionally, because everything runs through a

5 connection manager, there are often miscommunications, synchronization problems, and
bottlenecks between the user applications and the database.

If other databases were static and the data source became inactive or went down
for whatever reason, the data manager would not be able to tell when the data source
became active again. Thus, subsequent queries would still detect an inactive data source.
10 In order to establish another connection with the data source, the whole system would
have to be reinitialized. In situations where the data manager managed multiple users,
this reinitialization would affect remote users whose connection to a data base was
functioning normally.

Thus, it would be an advancement in the art to provide a system and method for
15 connecting a plurality of remote applications with a data source in a simplified way.

It would be a further advancement in the art to provide such a system and method
which would remove the likelihood of bottleneck by removing the necessity of routing
every communication between the interface module and data source through the
connection manager.

20 It would be a further advancement in the art to provide such a system and method
that was dynamic and reliable and did not have to reinitialize if the data source became
inactive or "went down."

Such an apparatus and method in accordance with the present invention is
disclosed and claimed herein.

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SUMMARY OF THE INVENTION

The present invention solves many or all of the foregoing problems by introducing a system and method by which a plurality of remote applications can connect with a data source without having all communication pass through a simple connection manager.

10 In one aspect of the invention, a system includes an interface module configured to interface with a remote application, a port module to interface between the interface module and the data source, and a connection manager module to facilitate the direct interface between the interface module and the port module. The connection manager may establish a connection between the connection manager and the port module. In one
15 preferred embodiment, the port module reports its availability to the connection manager through this connection. This may be done by the connection manager retrieving a port module identifier, which identifies an available port module for connecting to the data source from a data structure. The port module identifier may then be passed to the interface module so that the interface module may connect directly to the port module,
20 and thus, the data source.

The system in one preferred embodiment is configured to support HTML and provide interfacing between the requesting application and the data source. The interface module may be configured to convert the command from the remote application to a structured query language format to support interfacing with the data source.

5 In another aspect of the invention, a method for connecting a plurality of remote applications with a data source includes the steps of providing at least one interface module configured to interface with a remote application, providing at least one port module to interface between the interface module and the data source, and providing a connection manager to facilitate the interface between the interface module and the port module. In a preferred embodiment, the method further includes establishing a direct connection between the interface module and the port module. A port module identifier for an available port module may be returned to the interface module for direct connection between the interface module and the port module.

15 Thus, it is an object of the invention to provide for the management of the connection between remote applications and a data source which alleviates bottlenecks in the data flow. It is another object of the invention to simplify the connection process by reducing the steps in the connection process. It is yet another object of the invention to reduce the need to synchronize each module used in the connection process.

20 These and other objects, features, and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

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BRIEF DESCRIPTION OF THE DRAWINGS

These and other more detailed and specific objects and features of the present invention are more fully disclosed in the following specification, with reference to the accompanying drawings, in which:

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Figure 1 is a schematic block diagram of a computer system suitable for implementing one embodiment of the invention;

Figure 2 is a schematic block diagram of one embodiment of a system in accordance with the present invention;

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Figure 3 is a schematic block diagram illustrating the components of one embodiment of a system for connecting a plurality of remote applications with a data source;

Figure 4 is a schematic block diagram illustrating more details of the embodiment of Figure 2;

Figure 5 is a schematic block diagram of a data structure for use in the system for connecting a plurality of remote applications with a data source.

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Figure 6 is a schematic block diagram of a data structure for use in the system for connecting a plurality of remote applications with a data source;

Figure 7 is a schematic block diagram illustrating the components of an alternative embodiment for a system for connecting a plurality of remote applications with a data source; and

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Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure to be used, produced, or operated on during execution of an executable. The operational data may be collected as a single data set, or may be

5 distributed over different locations including over different storage devices, and may at least partially exist merely as electronic signals on a system bus or network.

Figure 1 is a schematic block diagram illustrating a computer system 10 in which a plurality of modules may be hosted on one or more computer workstations 12 connected via a network 14. The network 14 may comprise a wide area network (WAN) or local
10 area network (LAN) and may also comprise an interconnected system of networks, one particular example of which is the Internet.

A typical computer workstation 12 may include a central processing unit (CPU) 16. The CPU 16 may be operably connected to one or more memory devices 18. The memory devices 18 are depicted as including a non-volatile storage device 20 (such as a
15 hard disk drive or CD-ROM drive), a read-only memory (ROM) 22, and a random access memory (RAM) 24.

Preferably, the computer workstation 12 operates under the control of an operating system (OS) 25, such as OS/2®, WINDOWS NT®, WINDOWS®, UNIX®, and the like. In one embodiment, the OS 25 may provide a graphical user interface (GUI) to
20 enable the user to visually interact with the modules of the present invention. In one embodiment, the OS 25 may be loaded from the non-volatile storage device 20 into the RAM 24 at the time the workstation 12 is booted.

The workstation 12 may also include one or more input devices 26, such as a mouse and/or a keyboard, for receiving inputs from a user. Similarly, one or more output

5 devices 28, such as a monitor and/or a printer, may be provided within, or be accessible from, the workstation 12.

A network interface 30, such as an Ethernet adapter, may be provided for coupling the workstation 12 to the network 14. In one embodiment, the workstations 12 may be coupled to the network 14 via a distributed remote data architecture (DRDA).

10 Where the network 14 is remote from the workstation 12, the network interface 30 may comprise a modem, and may connect to the network 14 through a local access line, such as a telephone line.

Within any given workstation 12, a system bus 32 may operably interconnect the CPU 16, the memory devices 18, the input devices 26, the output devices 28, the network
15 interface 30, and one or more additional ports 34, such as parallel and serial ports.

The system bus 32 and a network backbone 36 may be regarded as data carriers. Accordingly, the system bus 32 and the network backbone 36 may be embodied in numerous configurations, such as wire and/or fiber optic lines, as well as electromagnetic channels using visible light, infrared, and radio frequencies.

20 In general, the network 14 may comprise a single local area network (LAN), a wide area network (WAN), several adjoining networks, an Intranet, an Extranet, or, as in the manner depicted, a system of interconnected networks such as the Internet 40. The individual workstations 12 may communicate with each other over the backbone 36 and/or over the Internet 40 using various communication techniques.

5 For instance, different communication protocols, e.g., ISO/OSI, IPX, TCP/IP, may be used within the network 14. In the case of the Internet 40, however, a layered communications protocol (i.e. TCP/IP) generally best enables communications between the differing networks 14 and workstations 12.

10 The workstations 12 may be coupled via the network 14 to application servers 42, and/or other resources or peripherals 44, such as scanners, printers, digital cameras, fax machines, and the like. External networks, may be coupled to the network 14 through a router 38 and/or through the Internet 40.

15 Referring now to Figure 2, a data source connection management system 200 of the present invention is shown. In one embodiment, a web browser 202, is part of a computer station 204. The work station 204 may contain a plurality of modules (not shown) containing executable code and operational data suitable for operation within the memory devices 18 of Figure 1. Of course, the memory devices 18 in which the modules of the present invention are located may also be distributed across both local and remote computer workstations 12 (Figure 1). Likewise, two or more illustrated modules may be
20 integrated into a single module without departing from the scope of the invention.

The present invention may be used over the Internet 40 in conjunction with a conventional web browser 202. The web browser 202 interprets HTML documents and formats and defines web pages 204. The web browser 202 may be at a remote workstation 12 (Figure 1) and may be connected through the Internet 40 to a web server

5 206. The web server 206 stores HTML documents and interacts with the web browser 202 for downloading and uploading the documents for generation of web pages 212.

By way of example, a user at a remote application such as a web browser 202, may want to search for a book on a book store web server via the Internet. The web browser 202 connects to the server 206. The server 206 invokes an interface module 208,
10 which allows the remote user to specify a keyword in a book title for example. The interface module 208 will pass the request to a data source 210 and receive data in return in the form of a data file. The file can then be used to create a web page 212 either at the server 206 or at the remote user's web browser 202.

Referring now to Figure 3, the system 200 of the present invention includes a
15 connection manager 220. The connection manager 220 is a module that may include any type of computer instruction or computer executable code located within a memory device and/or transmitted as electronic signals over a system bus or network. It may comprise one or more logical blocks of computer instructions, which may be organized as an object, procedure, function, or the like. In one preferred embodiment, the connection
20 manager 220 is running in the background on the server 206.

The connection manager 220 is also configured to interface with at least one interface module 208. The connection manager is preferably located at a predetermined address to allow the interface module 208 to readily connect to the connection manager 220. Each interface module 208 is also configured to interface with a remote application

5 202 which may be a web browser connected to the interface module 208 through the Internet 40.

The connection manager 220 also interfaces with a plurality of port modules 222. Each port module 222 may be associated with one or more data sources 210 and is identified by a port module identifier and the data source 210 with which it is associated.

10 The port module 222, connection manager 220, and interface module 208 may each have their own separate executable code. In a presently preferred embodiment, each of the port modules 222, connection manager 220, and interface modules 208 communicate with each other using TCP/IP protocol, which allows the present invention to be easily transported between various operating system platforms such as Unix, OS, or Windows.

15 The interface module 208 seeks a connection 224 with the connection manager 220 at the predetermined connection manager address. As will be discussed in greater detail below, the connection manager 220 will determine which data sources 210 are available to the remote application 202 and which port modules 222 are associated with each data source 210. The connection manager 220 will identify a port module 222 that
20 is active, but not currently busy operating as the port or gateway to the database for an interface module 208. The connection manager 220 will return the port module identifier to the interface module 208 to allow the interface module 208 to establish a direct connection 226 with port module 222 and thus, the data source 210.

25 Instead of the connection manager 220 repeatedly having to communicate with each port module 222 and each interface module 208 involved with a data source query

5 for multiple port modules 222 and interface modules 208, the connection manager 220 simply tracks which port modules 222 are busy. When the interface module 208 requests a port module 222 for connection to the data source 210, the connection manager 220 simply provides or identifies a location of an available port module 222 which can then communicate directly with the interface module. It will be appreciated by those of skill in the art that this configuration and method will eliminate information bottlenecks at the connection manager 220.

Referring now to Figure 4, a remote application connects to a web server 206 to request information from a data source 210 which in one preferred embodiment is on the server side. For most data sources, the request must be converted into an SQL command. The request is sent to an interface module 208 which reads the request and formats it into an SQL command. Both the web server 206 and the interface module 208 may be resident on the server side. Further, the web server 206 or the interface module 208 may convert the remote application request into an SQL query.

The connection manager 220 then determines an available port module 222 and returns the location of the port module 222 to the interface module 208. The request may then be sent as an SQL command 230 to the data source 210 directly through the port module 222. In one embodiment, the data source 210 may be a database system 210 such as a relational database, but hierarchical and object-oriented databases are also within the scope of this invention. In other preferred embodiments, data sources may include JAVA or PERL applications. In embodiments where data sources other than relational databases

Referring now to Figures 4, 5, and 6, each port module is known by an associated database and port module identifier. In one embodiment, a data structure 240 includes entries 242 containing the name of the data source 210, a minimum number of port modules 222 associated with the data source 210, and a maximum number of port

5 modules 222 associated with the data source 210. In one presently preferred
embodiment, the data structure is a data source array 240. It will be appreciated by those
of skill in the art that any type of data structure or storage device may be used to store
information of the type stored in the data source array 240.

A second data structure 244 indexes the data source array 240 and includes
10 entries 246 containing data regarding each port module 222 associated with a particular
data source 210. Each entry identifies which data source each port module belongs to, the
port module identifier, and a status, which states whether the port module is busy or
available.

In a preferred embodiment, the data structure 244 is a port module array 244. It
15 will be appreciated by those of skill in the art that any type of data structure or storage
device may be used to store information of the type store in the port module array 244.

The connection manager 220 returns a port module identifier of an available
particular port module 222 to the interface module by checking the availability status for
the port module 222 associated with the data source 210 that is the object of the data
20 request or SQL command 230. The availability status of a port module 222 may be
determined by a number of factors. Upon initialization of the connection manager 220,
the minimum number of port modules, as stored in the data source array 240 are launched
and available for connecting to an interface module 208.

Once a port module 222 is connected to an interface module 208, that port
25 module 222 is no longer available and its status changes to busy or unavailable. Once a

5 busy port module 222 is no longer occupied by an interface module 208, its status is updated from busy to available and passed along to the connection manager for storage in the port module data structure 244. Each port module 222 may be configured to refresh or restart itself after a predetermined period of time, or after a particular event, such as the occurrence of an error.

10 In a presently preferred embodiment, each port module 222 is configured to know its availability status and continually report that status to the connection manager 220 for storage in the port module array 244. It will be appreciated by those of skill in the art that in this configuration, the connection manager 220 need not initiate contact with the data source 210 every time a request or SQL command passed from the interface
15 manager 208. That would be time consuming, especially for data sources residing on main frames. Instead, the connection manager 220 need only determine the first port module 222 having an “available” status and pass the corresponding port module identifier to the interface module 208 for direct connection 226.

It will be appreciated by those of skill in the art that there are many ways for
20 connection manager 220 to determine the first available port module 222. One such way includes storing the port module identifier for each available port module 222 in a queue (not shown). In one preferred embodiment, the queue may include a first-in-first out array. If the status of an “available” port module 222 changes, the associated port module identifier is removed from the queue. The connection manager 220, need only check the
25 queue of “available” port module identifiers to find an available port module 222.

5 In one preferred embodiment, the connection manager 220 may be configured to launch additional port modules 222 up to the predetermined maximum number of port modules 222 for a particular data source 210; the number being stored in the data source array.

10 It will be appreciated by those of skill in the art that the storage of information such as that stored in the arrays 240, 244 may be accomplished in various ways using various data structures. It will further be appreciated that these arrays 240, 244 or data structures 240, 244 may be part of the connection manager 220, the port module 222, the interface module 208, or may be a separate module, and still provide the necessary information to enable a direct connection 226 between the interface module 208 and the
15 port module 222 after the manner of the present invention.

In one preferred embodiment, communication between the interface module 208, connection manager 220, and the port module 222 may be subject to authentication as a security measure. It will be appreciated by those of skill in the art that the data source array 240 and/or the port module array 244 may also include user identification or
20 password data for use in verifying or authenticated the relevant communications. It will further be appreciated that any such identification data may be part of a separate module, or hard coded into the system 200.

Referring now to Figure 7, one preferred embodiment of the present invention includes an arbitrary set of parameters, which may be embodied as a log file 250
25 associated with the connection manager 220 and each port module 222. Each log file 250

5 contains data 252 relating to the activity of the port module 222 and connection manager
220 to facilitate the tracking of data flow through the system 200. The data 252 in each
log file 250 may include, for example, the date, time, a previous SQL statement or
request, a present SQL statement or request, a number of rows, a warning message, an
error messages, a feature database schema, a number of records, and the like. Because
10 each port module 222 will have a port module identifier and data source identifier, a user
may track the how many, and what type of, SQL statements passed to the data source 210.
One may also determine the time of the last SQL statement or request to the data source
210 and other information at predetermined points in the process.

It will be appreciated by those of skill in the art that this information would
15 facilitate debugging the system 200. For example, users at a remote application 202 that
may be creating or programming a web page that utilizes data stored at a data source 210
may check the log files 250 to track down an error in the application.

Each port module 222 and the connection manager 210 writes to a log file 250,
which in one preferred embodiment is stored as a flat file. In a presently preferred
20 embodiment, the log file 250 has a maximum storage capacity of one megabyte. Once the
log file 250 is full, another log file 250 may be generated. The log file 250 in accordance
with the present invention is dynamic. The data 252 stored in the log files 250 is
continually updated as the system 200 operates. It will be appreciated by those of skill in
the art that various sizes or types of files can be used to store the data 252 contained in the

5 log files 250. Of importance is the fact that the data 252 in the log files 250 is accessible to the remote application 202.

The log file 250 is configured such that a user at a remote location 202 can view the data 252 stored in the log files 250 on a screen, print out the data 252, or send it to another application. The user of a remote application 202 may also determine which of
10 predetermined types of data will be stored in the log files 250. The user may set the log files 250 at a maximum level so that a maximum amount of data is stored in the log files 250. The user may also set the log files 250 to store a minimum level of data. It will be appreciated by those of skill in the art that the system 200 will run more efficiently when the amount of data 252 stored in the log file 250 is set to a minimal level.

15 In one preferred embodiment, the log file 250 stores a change in status of the data source 210 from active to inactive. Thus, the port module 222 knows whether the data source 210 was "down" the last time the port module 222 was connected to the interface module 208. When the connection manager 220 seeks to establish a connection with the data source 210 through the port module 222, the port module 222 will check the last
20 status of the data source 210, to which it is assigned to determine whether the data source 210 was active or inactive. If the last detected status indicated that the data source was inactive or "down," the port module 222 will reestablish a connection with the data source 210.

The connection or reconnection between the port module 222 and the data source
25 210 may be transparent to the interface module 208. If the data source 210 is down, then

5 the port module 222 will send the interface module 208 an error message stating that the
data source 210 is down. When the data source 210 becomes active or is otherwise
accessible again, the entire system 200 does not have to stop and restart in order to
reestablish a connection between the interface module 208 and the data source 210. The
port module 222, because it knows that the data source 210 was down during its last
10 connection, will reestablish a connection with the data source.

One of skill in the art will appreciate that if the connection manager 220 had to
reinitialize, all of the part modules 222 attached to the connection manager 220, even
those whose connection to a respective data base was functioning fine, would reset, thus
interrupting a data search. Thus, it is an advantage of the present invention for the port
15 module 222 to be able to determine the last status of the data source 210, and be able to
reconnect to its data source 210 without the connection manager 220 having to
reinitialize. This enhanced error recovery makes the system more reliable. Most
importantly, users see the system as more reliable and less temperamental, requiring less
interaction.

20 Referring to Figure 8, a flow diagram 300 which incorporates one embodiment
of a method of use of the system 200 of Figures 2-7. In step 302, the method begins. A
remote application, such as the web browser 202 requests data from a data source 210.
The request may be sent over the Internet 40 to the web server 206, which provides 304
the interface module 208 which translates the request into a suitable search command
25 such as SQL.

5 The connection manager 220 is initialized 306 for communication with the
interface module 208. The connection manager 220 identifies 308 and stores the location
of the port modules 222 associated with a particular data source 210. The port modules
222 serve as the connection port to the data source 210 for the interface module 208. The
connection manager 210 facilitates the communication between the interface module 208
10 and the connection manager 220. The connection manager 220 establishes a connection
with the port module 222 and determines 310 whether the port module 222 is available.
Each port module 222 is associated with a particular data source 210 and identified by a
port module identifier, which are each stored in a suitable data structure. A port module
identifier for an available port module 222 is returned 312 to the interface module 208. A
15 direct connection is established 214 between the interface module 208 and the port
module 222.

 In one preferred embodiment, the connections between the interface module 208,
the connection manager 220, and the port module 222 are authorized to facilitate secured
communications.

20 The request 314 converted into SQL is passed to the data source 210 and the
retrieved data 316 is inserted 318 into an HTML format to support interfacing between
the remote application 202 and the data source 210. The method may then be repeated
320 for additional data source requests or queries. If there are no further requests, the
remote application 202 disconnects from the server 206 and the method terminates 322.

5 In one embodiment, an arbitrary set of user-selectable parameters reflects a status of the connection between the remote application and the data source. These parameters may include a present SQL request, a warning message, an error message, a date, a time, a previous SQL request, a feature database schema, and/or a number of records. Data associated with these parameters may be passed to a log file 250 at various stages in the process. In one preferred embodiment, the data is transmitted 324 to the log file 250 according to condition selected by a user. For example, the user may want to maximize efficiency in the process by limiting the fields or parameters of data sent to the log file. On the other hand, the user may want to obtain as much information as possible in order to better debug the system or track data flow in greater detail.

Transmitting 324 the data associate with the parameters to the log file 250 may be performed at various times throughout the method 300. Accordingly, the step of transmitting 324 may be identified as a sub-step 324 which may be performed after or in conjunction with other steps of the method 300. Thus, transmitting 324 is illustrated in Figure 8 at more than one location for illustrative purposes only. One of skill in the art will appreciate that the step of transmitting 324 may be performed at any number of locations in the method 300.

In one preferred embodiment, the data stored in correlation with the arbitrary set of parameters is arranged in a hierarchical relation. At least one parameter of the arbitrary set of parameters corresponds to an output device selected by a user. For

5 example, the user may select to view the data in the log file 250 on the screen or by sending it to a printer.

The invention provides for the management of the connection between remote applications and a data source which alleviates bottlenecks in the data flow. The system and method of the present invention simplifies the connection between the remote application and the data source process by reducing the steps in the connection process. 10 The system and method of the present invention eliminates the need to continually synchronize the interface module 208 with the port module 222 for each data source 210 request. The invention may be readily adapted to existing software applications such as web browsers, web servers, database management systems, operating systems and other modules disclosed herein. 15

The present invention may be embodied in other specific forms without departing from its scope or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope. 20

What is claimed and desired to be secured by United States Letters Patent is: